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FRIDAY, JUNE 17, 1921

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SCIENCE

FRIDAY, JUNE 17, 1921

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A DECADE OF AMERICAN MATHEMATICS

THE year just closing carries with it into the past another calendar decade, and the fact suggests that I take up with an audience representing the mathematical section of the American Association for the Advancement of Science and the two other mathematical societies meeting with it, a sketch of the progress of our science in this country during the decade. In doing this, I am led to reflect, when I think of the struggle that has marked the period, that though it is difficult to see how a thoughtful and disinterested person can enthuse over international rivalries in territory, dominion, trade advantages or other details of national prestige which are pregnant with dangers of destruction far beyond any possible advantages gained, a desire for national preeminence in scientific attainment is most wholesome and valuable.

I wish I might, therefore, compare the work of America during the decade with that of other countries. But even if this were fair, in view of the handicap the war has imposed on other countries, it would inevitably entail a sitting in judgment on questions of value over a field so broad, with so large a body of workers, that I have hesitated to assume the competency or to appropriate the time requisite to a proper performance of the task.

Instead, I am restricting myself to a review of some aspects of the work of this country alone, seeking to find the directions it has taken, to find some of the respects in which it has been weak, and in which strong, and to draw a few conclusions as to strengthening it in the future.

As to an anlysis of the contributions made, you will agree that since over 1,200 articles

[1] Address delivered as retiring vice-president of Section A of the American Association for the Advancement of Science, at Chicago, Dec. 29, 1920.

have been published since 1910, a detailed examination of those articles would be impossible. I have, as a matter of fact, obtained what I believe to be a fairly complete list of these artcles, and made a rough classification of them according to subject matter. Perhaps a quantitative comparison, based on numbers of pages, would have been more informative than one based merely on numbers of titles, but this too would have been open to criticism, and somewhat more difficult to obtain and digest. If you will bear in mind the meaning of the figures given, I have little fear that you will over-estimate their significance, or infer that I have any disposition to propose *any* quantitative test as the sole measure of the excellence of an individual's scientific output. On the contrary, I should prefer six pages of Fredholm's in the *Proceedings* of the Royal Academy of Science of Sweden of 1900 to scores of titles and many hundred pages that might be picked out from journals on the other side, or this side, of the water.

The limitations on the statistical field before us must first be stated. It includes no historical, biographical, or philosophical contributions, and only such in applied mathematics as were contributed by men primarily mathematicians, or appeared in journals devoted entirely to mathematics. It does not, moreover, contain articles contributed to journals of primarily didactic emphasis. Otherwise, it is intended to be complete, and contains contributions to a considerable number of foreign periodicals.

I wish to consider first the distribution of effort amongst various sub-fields of mathematics, and then to comment on some other aspects of interest presented by the data collected. In the matter of classification, in addition to certain customary headings, I have endeavored to separate out a few other classes of subjects of interest for the purposes in hand: first, certain topics whose present vitality and interest among mathematicians generally have been pointed out by Bliss, Van Vleck and others on occasions similar to this, and secondly some topics characteristically American in that Americans have taken a significant or preponderant part in their development. The distribution of titles among the headings selected follows, the numbers given being the percentages of the total number of titles found, or 1,258.

Algebra		
Groups	8.9	
Theory of numbers (including theory of irrationals)	6.0	
Theory of equations, matrices and determinants	4.8	
Higher complex algebras	1.8	
Modular analysis	1.7	
Invariants	1.4	
Combinatory analysis	1.1	
Probabilities and statistics	0.5	
		26.2
Analysis		
Theory of functions of one or more complex variables	6.4	
Theory of functions of a real variable	6.0	
Differential equations	4.3	
Sturmian problems, including Fourier Series	3.9	
General analysis, calcul fonctionel	2.9	
Integral equations	2.5	
Calculus of variations	2.3	
Analysis situs	2.1	
Theory of integration (Lebesgue, etc.)	2.0	
Difference equations	1.2	
Functions of infinitely many variables	1.1	
Point sets	1.0	
Other analysis	5.3	
		41.0
Geometry		
Metric differential geometry	6.0	
Analytical geometry of curves and surfaces	5.7	
Geometry of hyperspace	2.0	
Geometric transformations	1.4	
Projective differential geometry	1.7	
Configurations of a finite number of elements	1.0	
Geometry of forms	0.9	
Modular geometry	0.8	
Congruences and complexes	0.6	
Projective geometry (other than differential)	0.6	
Non-Euclidian geometry	0.5	
Other geometry	1.0	
		22.2

Applied mathematics		
Mechanics of continua (including potential theory and electro-magnetic phenomena)	4.7	
Kinematics and geometrical mechanics	1.7	
Celestial mechanics	1.7	
		8.1
Postulate theories		2.5
		100.0

It will be noticed that algebra and analysis constitute about two thirds of the whole, though this is not surprising in view of their large variety of phases and methods. Their share, however, is larger than in most countries, doubtless because of the prevailing tendencies in the countries to which our mathematicians went for training during the closing decades of the last century. I can not help feeling that a more even balance would be desirable, because of the considerable suggestive help of the more intuitive branches of mathematics. Particularly does it seem regrettable that mathematical physics has not received more attention from mathematicians. It is true that some work has escaped a place in the data of the present study because it has not found its way into mathematical periodicals. For instance, a former member of the ordnance department has told me that he has in his possession over a hundred copies, mostly unpublished blue-prints, of articles on ballistics. But in view of the reputed practical temperament of the American people, in view of the racial traditions we might naturally have inherited from Great Britain, in view of its service to mathematics through its great suggestiveness of interesting problems, and in view of the service of mathematics, through mathematical physics, to physics and engineering, it does seem clear that a greater cultivation of this field in this country is most desirable. In fact, it might almost be considered as characteristic of the decade that this desideratum has been repeatedly and forcefully pointed out.

One reason for the situation which exists is to be found in our tendency to early and over specialization. Our physics departments are apt to load their students with their own courses, with emphasis on the experimental side, often content to have their graduates equipped with the calculus and a formal course in differential equations; while, on the other hand, little physics is usually required of students concentrating in mathematics. This is in part due to lack of mutual confidence, and in part to the student's own haste to receive his degree. Instruction in mathematical physics should be given by mathematical physicists. But until we have produced a more adequate supply of these, mathematician and physicist must cooperate. We can at least offer courses in those parts of mathematics which are of fundamental importance to physics, and in which details of rigor are replaced by cautions, in case of real danger, and in which a sympathetic attitude toward a desire to find out how nature works replaces a disdain for everything aside from the mathematical game, the instructor bearing in mind that the physicist has always the appeal to experiment with which to check his logic. On the other hand, it is probable that lecture courses in physics would be more frequented by students of mathematics if an attempt were consistently and constantly made to draw a clear line between mathematical consequences of previously established results and fresh appeals to experiment or new physical hypotheses. The more this distinction can be made, and the more the physical assumptions can be simplified and gathered into groups at the beginning of course or topic, the more will the course be likely to appeal to the student with mathematical predisposition.

Returning to our table for a glance at the distribution of effort we find the place occupied by algebra even higher than we should expect. This is largely due to the work of two men, Dickson, in the theory of numbers, of groups, and in allied subjects of algebra, and Miller, in the theory of groups. Other investigators whose work has enriched this field include Blichfeldt, Carmichael, Vandiver, Bell and Lehmer, in the theory of numbers; Glenn, Carmichael, Coble, Curtiss, Bennett, Metzler,

Wedderburn and Rice in the theory of equations, matrices and determinants; Miss Hazlett and Glenn in invariants and in modular analysis; W. A. Manning and H. H. Mitchell in the theory of groups; E. B. Wilson and Shaw in vector theory and higher complex algebras; Rietz and Dodd in probabilities and statistics; White, Coble and Cole in combinatory analysis.

Under the heading of analysis proper, in which the notion of limit plays a role, we find the theory of functions of complex variables taking first place. Our progress along these lines is largely due to Osgood, although there is also found a gratifying variety of contributions on conformal mapping, the theory of algebraic functions, and special analytic functions by Lefschetz, Gronwall, Haskins, and others. The theory of functions of a real variable would normally come higher on the list but for the fact that certain topics usually here included have been separated out, such as Fourier series, point-sets, etc. The theory of functions of a real variable is characterized by the fact that it has a larger number of individual contributors than the other topics, although the work of Blumberg deserves special notice. The field of differential equations, apart from Sturmian problems, has had, except for three fundamental papers of Birkhoff, comparatively little and scattered attention. Macmillan and Lipka have, however, written interesting papers on this topic. In the field of Sturmian problems including boundary value problems, oscillation and expansion problems, we may take distinct satisfaction in the valuable work of Bôcher, Richardson, Birkhoff, Jackson, and their pupils and followers. The calculus of variations, once characterized by Schwarz as the most interesting and difficult branch of mathematics, has had comparatively few devotees, but contributions of importance have been made by Bliss, certain of his pupils, by Dresden and E. V. Miles.

I wish now to speak briefly of certain comparatively new branches of analysis. Professor White once pointed out in an interesting statistical review of mathematical development[2] a distinct tendency to follow fashions. The reflection that men are apt to be stimulated by each other's work may rob this fact of some of its surprise, but the substantiality of the fact can not be denied. Of course when a new domain is opened up by fundamental discoveries, it is to be expected that sooner or later the event will be followed by a widespread and rapid development of that domain. An interesting example of a delay in such development is found in the fact that Fredholm's paper on integral equations, above alluded to, lay for two years unnoticed until the labors of Hilbert gave it its due prominence. New domains of the sort alluded to are at present: the still vital subject of integral equations, the related field of functions of infinitely many variables (though Hill and von Koch considerably antedate Fredholm), the theory of generalized integrals opened up by Lebesgue, general analysis, due to E. H. Moore, Fréchet and Volterra, and one or two other fields to be mentioned presently. It seems to me that in view of the general attention being given to these subjects, American interest in them has been distinctly less than it should have been. General analysis leads, with 2.9 per cent. of the total number of papers. The general analysis of Moore has been ably cultivated by his pupils, Hildebrand, Chittenden, and others, while the calcul fonctionel has had fewer devotees. But along the latter lines should be mentioned the papers of C. A. Fischer, Evans, and the two articles of Bliss inspired by his work in ballistics. The cultivation of integral equations in this country has been due to several influences. Besides the general theory of Moore, we find interest in the subject stimulated by Bôcher and Volterra, the contributions coming mainly from the pens of Mrs. Pell, Hurwitz, and Evans, respectively. The theory of functions of infinitely many variables receives more than one contribution each from but two authors, Hart and Daniell.

I have given a special place to analysis situs

[2] Science, new series, Vol. 42, pp. 105–113, 1915.

because it seems to me that the work of Poincaré and others, including Birkhoff in this country, has emphasized the growing importance of qualitative mathematics in dynamical problems. The showing here is good, including interesting contributions from Veblen, Alexander, Birkhoff, R. L. Moore, and Kline. The closely related topic of point sets, whose vital connection with geometry and dynamics was forcefully pointed out by Van Vleck in his address as retiring president of the American Mathematical Society in 1915, claims but one per cent. of the total number of titles, the articles on this subject coming from Van Vleck, R. L. Moore, Blumberg and Kline. In the theory of integration we find 1.2 per cent. of the titles, Bliss and Daniell being the principal contributors.

While geometry does not seem to have had its full share of attention, we are well represented in differential geometry, largely because of the labors of Eisenhart, Wylczynski, Kasner, G. M. Green, Graustein and others. Further branches of geometry in which Americans have labored productively are: the geometry of algebraic varieties, in which Lefschetz has done notable work; the geometry of special classes of curves and surfaces, cultivated by Snyder, White, Emch, Sisam, Ranum, Roe and others; the geometry of forms; modular geometry, by Dickson, Glenn and Coble; the geometry of hyperspace, by C. L. Moore and Eiesland; transformations, by Snyder, Sharpe and others; non-Euclidean geometry; while a number of memoirs on different aspects of geometry have been contributed by Coolidge.

The work in mathematical physics has been due almost solely to four men: Bateman, Gronwall, Webster and Roever. Progress in celestial mechanics is to be credited almost entirely to F. R. Moulton and his pupils and to Birkhoff. The work of Birkhoff in the field of dynamical systems has been conspicuous.

In postulate theory, the papers of Huntington, R. L. Moore, and Scheffer have aroused much interest.

The above review lays claim only to being a sketch, and doubtless overlooks single papers of real importance. It does, however, give some idea of the fields being cultivated, and of the more prominent figures in them. Not as an afterthought, but with singular pleasure, do I allude to several developments which are peculiarly American, in that they were largely initiated and cultivated on this side of the ocean: to Moore's general analysis already touched upon, and to Wilczynski's projective differential geometry, ably initiated by him and carried on by himself and pupils, and to the all too short-lived Green—to Kasner's geometrical mechanics, and to the theory of linear difference equations in the hands of Birkhoff, Carmichael and their pupils. While one might wish a more extensive cultivation of such branches as are largely indigenous, it seems to me that their very existence furnishes some evidence of the vitality of American mathematics, and a foundation for predictions that its importance is on the increase. Doubtless there are other evidences of the same sort of thing that have escaped my attention.

A few further remarks on the statistics gathered may be of interest. The 1,258 titles found were the contributions of 325 persons. Nearly half of this number contributed but one paper each. I think it fair to assume that two thirds of the latter had recently received their doctorates and were writing their first and last paper at the same time. This large "mortality" indicates a great waste of intellectual capital, and deserves careful consideration. Some of it means the diversion of energy of able investigators into the instruction of pupils who might be predicted to be unproductive, and some of it is due to the crushing out of scientific enthusiasm in really able young mathematicians by an unsympathetic or over-exacting environment. The "treatment indicated" must be decided upon in the individual cases.

I have heard the advice given to young scientists, that if they wish to show the greatest productivity, the best way to accomplish this is by a high degree of specialization. The results of the present study bear this out, though not to the extent one might anticipate.

For one third of the twelve most productive mathematicians have papers scattered over a half dozen different fields each. Doubtless the advice given is particularly apt in cases where industry is a more predominant characteristic than elements of genius. But it does seem as if actual productive experience in different domains did, in some cases, add to the mathematician's power, by suggesting ideas, analogies and methods. It seems to me also to have a steadying effect on one's sense of values. He who sits in judgment on the value of scientific work is in a precarious position. To be sure, it must be done, by editors, if not by others. I have sought for some time a satisfying criterion of values. Probably no absolute criterion exists. The best working test I have been able to find, both in my own judgment and in that of those mathematicians with whom I have discussed the question, is to be found in the degree of relationship of the investigation to be judged with other branches of mathematical or allied sciences whose vitality and interest are recognized. If this solution is at all an acceptable one, it is at once clear how experience in different fields may enhance the value of the worker's product.

It may be of interest to note, in these times of agitation for cooperative research, that less than 3 per cent. of the titles listed were of joint papers, and of these not one bore evidence of being inspired by the movement. While cooperative investigation in mathematics should have all the trial it can get, it is evident that men are not likely to take to it naturally in any great degree, though there have clearly been instances in which investigators, brought together by community of interest, have distinctly enhanced their product by collaboration.

In addition to publications in journals, there are the books which have appeared during the decade. The number of books on higher mathematics which Americans have published in this time barely exceeds three score. Titles of American books in the lists of current publications in higher mathematics are as needles in a haystack. The value to American mathematics of authoritative and up to date handbooks by American authors has been sufficiently emphasized to need no further comment here. The books which have appeared include a sufficient number of treatises of such excellence as to leave no doubts as to the capabilities of authorship in this country. Three, at least, of them, have been translated into French or German; two, written in these languages, enjoy large sales here and abroad. The problem is an economic one, and the desirability of subsidy encouragement has been pointed out. All I wish to do here, is to suggest the help each individual can give by buying such books whenever possible, and by recommending their purchase by libraries.

Our sketch of the decade should not terminate without mention of the fact that a half dozen Americans have been elected to foreign academies, and that in three instances Americans have been the recipients of prizes or medals from such organizations, and in a further instance, of an honorable mention. The foreign recognition in these cases has been amply merited. The point is, of course, that by reason of national pride, of habit, of language barriers, recognition must of necessity lag behind merit. But some conscious effort on our part may well be directed toward the attainment of deserved recognition. It seems incontrovertible that if a bit of mathematics is worth writing, it is worth writing to be read. Otherwise the author is guilty of usurping pages in the journals and space on library shelves to no purpose but the gratification of vanity. This is not the place to enter upon a discussion of style, but one or two aspects of the matter have forced themselves upon my attention in connection with the present study. Style as a whole is, and doubtless should be, individual, and its development is largely merely a matter of conscious purpose. Its fundamental element for the mathematician is, of course, clarity. But when one looks over the standard reviews of mathematical literature, and notices the extent to which the reviewer takes his cue from the author's opening lines—frequently contenting himself with citing the author's own estimate of his work, it becomes clear that particular emphasis in

writing should be laid upon the opening paragraph. I suggest that without exception the introduction should be framed about the thought "this is an interesting and worthwhile contribution" (if the author has not this conviction, he ought not to ask it of the editor); that it ought therefore to give the historical setting of the problem in hand, an indication of its relationship with other problems of established importance or of recognized interest, either in mathematics or in allied sciences, with a clear indication of the novelty claimed in results or methods or presentation. If the author will then outline his general course of reasoning, he will further enhance the readability of his paper. Similar remarks apply to the presentation of papers at meetings of scientific societies. A paper should be made interesting, or be read by title. As long as the author conceives it to be an act of merit merely to go through the form of presenting a paper, so long will he deserve to have his audience melt away to talk of really interesting things in the corridors. It is, to be sure, a difficult task to make a highly technical subject of general interest, but it can be done by a placing of emphasis more on setting and less on detail, and the effort is a scientific duty.

I have alluded to the question of values. There is another side to this question, or perhaps rather another aspect of values that must not be overlooked. I have heard the question raised as to where or when our American LaGranges are to appear. There is little doubt but that young men of a high degree of genius exist in this country in every generation. That more of them do not find their way into mathematics, or, having found their way, do not continue on and develop there, is, to a considerable extent, a matter of environment. By cultivating a background of productive scholarship, by cultivating an appreciation of productive scholarship, something can be done toward producing a favorable environment. Ususally men of genius are as sensitive to appreciation, as responsive to encouragement, as any one else. The geniuses must have their audience of appreciative scientists, the less gifted producers must have their audience of interested readers, and the science as a whole must have a hold on popular respect.

Now nothing enhances a man's mathematical interests like a share in the development of the science, even though the share have but slight intrinsic importance. It seems to me therefore that it is desirable to have means of publication of papers of minor importance—it being understood that in respect to content or method some novelty and merit is present—both because the encouragement thus given may at any time be the occasion of stimulating effort destined to become of high value, and because the interest engendered is likely, at the least, to become a support to the more effective producers.

Just as an enormous impetus to mathematical work in this country was nearly coincident with the foundation of the New York Mathematical Society, so also I think we may reasonably look for a distinct impetus from the founding of the Mathematical Association of America, whose successful launching has been one of the important scientific events of the decade, and which has already brought to light a lively group of mathematical interests beyond the hope even of the founders.

Various ways of external encouragement of mathematical science in America have recently been discussed. They include the items I have mentioned, the encouragement of publication both of books and periodicals, they include prizes for important contributions, and they include recommendations for diminishing the distractions which hamper the scientist in the way of excessive instruction and administration. While I do not wish to suggest that more effective means exist, nor to imply that such steps ought not to be seconded most heartily, I do wish to point out that each individual can throw his added influence into the scale and help materially and immediately, first by efforts to produce, in the faith that such efforts will certainly result in his being more vitally a scientist and a more enthusiastic teacher of his subject; second, by cultivating a discriminating sense of value, and endeavoring to throw his pro-

ductive efforts into the most important channels which promise him some success; and thirdly by realizing his duty to make the value and interest of his own work, and of his science in general, appeal as widely as possible.

O. D. Kellogg

SUMMARY OF A REPORT OF THE PERMANENT SECRETARY CONCERNING THE AFFAIRS OF THE ASSOCIATION, SUBMITTED TO THE EXECUTIVE COMMITTEE AT ITS MEETING, APRIL 24, 1921

The following paragraphs present the main features of the permanent secretary's report for the period from October 1, 1920, to March 31, 1921.

In accordance with a vote of the Council at Chicago, Doctor Sam F. Trelease was appointed assistant secretary, beginning January 1. The assistant secretary has thus far been engaged mainly in editorial work on the new membership list.

The new volume of the Summarized Proceedings is far advanced and will soon appear from the press. It is planned to be more useful and satisfactory than the earlier volumes. It will contain the constitution and by-laws of the association, the summarized reports of seven annual meetings—from 1914 to 1920 (with citation references to Science for the important official publications), and the complete membership list corrected to the date of printing. The list contains about 12,000 names and addresses. Subscriptions for the new volume were booked at the price of $1.00 to members, until December 1, 1920, since which date the price to members has been $1.50. Over 1,600 volumes have been paid for in advance. (The present price will be maintained until the date of actual publication, after which it will become $2 to members and $2.50 to nonmembers. Subscriptions and remittances should be sent to the Permanent Secretary of the American Association for the Advancement of Science, Smithsonian Institution, Washington, D. C.)

The American Mathematical Society, which was invited to become affiliated with the association at the Chicago meeting, has ratified this affiliation and is now an affiliated society. The roll of the society includes 313 members of the association, of which number 107 are association fellows. The society is therefore entitled to two representatives in the council of the association.

Two state academies of science, the Michigan Academy and the Oklahoma Academy, have been added to the list of affiliated academies through their election by the council at the Chicago meeting. Each affiliated academy is entitled to a representative in the association council.

(With the two academies that were affiliated by the action of the Executive Committee on April 24—the North Carolina Academy and the Maryland Academy—there are now twelve affiliated academies, named as follows: Illinois, Iowa, Kansas, Kentucky, Maryland, Michigan, Nebraska, New Orleans, North Carolina, Oklahoma, and Wisconsin.)

The arrangement for the affiliation of academies allows the academy to collect the annual association dues of its national members (members who are also members of the American Association) and allows it to retain, for its expenses all association entrance fees obtained through its efforts and also one dollar of each payment of association annual dues collected by it. The permanent secretary's office supplies each affiliated academy with printed and addressed statement cards for all of its national members and these are sent to the members of the academy, so as to be received October 1 of each year (the beginning of the association fiscal year). For each $5 payment received in response to this billing the academy transmits $4 to the office of the permanent secretary, who then orders the free journal for each member so paying. (The journal can not be ordered until the $4 remittance is in the hands of the permanent secretary.)—Immediately after its affiliation each newly affiliated academy receives from the permanent secretary's office a payment amounting to one dollar for each one of its national members who has already paid his association dues for the current year. When a member of the association becomes a member of an affiliated academy after its affiliation the acad-

Name of Academy and Time of Its Affiliation.	Academy Allowances for		No. of New Members Received through Academy (Sept. 30, 1920, to March 31, 1921)	No. of National Members of Academy (March 31, 1921)	No. of National Members in Arrears for Association Dues (March 31, 1921)[1]
	1920	1921 (to March 31)			
Illinois (Feb. 20, 1920)	$187	$274	64	287	10
Iowa (April 24, 1920)	96	106	8	112	4
Kansas (April 24, 1920)	60	66	5	70	4
Kentucky (May 8, 1920)	23	43	12	43	0
Michigan (Dec. 27, 1920)	—	74	—	83	9
Nebraska (April 30, 1920)	100	98	2	117	18
New Orleans (May 21, 1918)	88	61	3	114	52
Ohio (May 14, 1920)	127	140	7	152	10
Oklahoma (Dec. 27, 1920)	—	18	2	23	3
Wisconsin (April 23, 1920)	74	116	45	190	10
Totals	$755	$996	148	1,191	120

emy is allowed to retain the usual dollar allowance *if it collects the annual association dues of such member after April 1,* but the allowance is *not effective for that year* if the member pays his dues before April 1.

The operation of academy affiliation is illustrated by the above table, for the years 1920 and 1921.

It appears that the affiliation arrangement for academies has thus far been very unprofitable in a financial way, but it is hoped that the financial loss by the association and the corresponding contributions toward the support of the academies may prove justifiable as expense incurred in promoting the advancement of science and education in the United States.

The present status of the membership of the association (March 31, 1921) is summarized below, together with corresponding data for 1920.

The expenses of the Chicago meeting, including those of the preliminary announcement, were nearly $4,000, of which about one-half was raised through local subscriptions secured by the Local Committee. The printing of the General Program cost $1,002.50 and the printing and mailing of the preliminary announcement cost $955.35.

Preparations for the annual meeting are exceptionally well in hand this year, the local committee having already begun its work, and

[1] The sum of the corresponding numbers in columns 3 and 6 does not agree exactly with the number in column 5, because members sometimes have to be transferred from the account of one academy to that of another because of change of residence.

Number of	March 31, 1920	Mar. 31, 1921
Active life members	353	350
Annual members credited with dues for current year	8,034	9,287
Members in good standing, total.	8,387	9,637[2]
Members in arrears for two previous years and current year.	915	424
Members in arrears for $2 on 1920 account and for current year	220	29
Members in arrears for one previous year and for current year.	618	773
Members in arrears for current year only	2,163	1,085[3]
Names on list, total	12,303	11,948

CHANGES IN MEMBERSHIP FROM SEPTEMBER 30, 1920, TO MARCH 31, 1921

	By Death	By Resignation	Dropped October 1, 1920, for Non-Payment of Dues	Total
Loss from list	36	361	1,620[4]	2,017
Gains, new members	—	—	—	859
New loss from list	—	—	—	1,158

[2] On April 21, this number had been increased to 9,852.

[3] On April 21, this number had been decreased to 870.

[4] It should be noted that this number is considerably larger than the normal expectancy on account of dropping for nonpayment of dues. The list during 1920 still contained all those names that should ordinarily have been dropped at the beginning of that year. On October 1, 1920, names were dropped for which there was an arrearage of 3 years, as well as those for which there was an arrearage of 2 years.

it seems certain that the Toronto meeting will be very successful in every way.

BURTON E. LIVINGSTON,
Permanent Secretary

THE EXECUTIVE COMMITTEE ON NATURAL RESOURCES

BEING THE UNION OF THE COMMITTEES APPOINTED BY THE NATIONAL ACADEMY OF SCIENCES, THE NATIONAL RESEARCH COUNCIL AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The following is the present membership of the Committee:

Representing the NATIONAL ACADEMY OF SCIENCES
- John C. Merriam, president, the Carnegie Institution of Washington
- John M. Clarke, director, New York State Museum
- J. McKeen Cattell, Editor of SCIENCE

Representing the NATIONAL RESEARCH COUNCIL
- John C. Merriam
- John M. Clarke
- J. McKeen Cattell
- Vernon Kellogg, secretary, National Research Council
- C. E. McClung, director, Zoological Laboratory, University of Pennsylvania

Representing the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
- John C. Merriam
- Henry S. Graves, former chief, U. S. Forest Service
- Isaiah Bowman, director, American Geographical Society
- Barrington Moore, president, American Ecological Society
- V. E. Shelford, professor of zoology, University of Illinois

Chairman, John C. Merriam

Vice-chairman, John M. Clarke

Secretary, Albert L. Barrows, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

Assistant Secretary, Willard G. Van Name, American Museum of Natural History, New York, N. Y.

Program

THE purpose in organizing this Executive Committee is to promote, by scientific effort and through education, the most reasonable use of our natural resources for the economic, industrial and social development of the country.

The American people have been richly endowed with natural wealth and have quickly availed themselves of their endowment. The first easy and quick production for the pressing needs of the growing population, followed by rapid strides toward the realization of wealth, have brought large elements of the natural resources to the danger line, some to more costly and lessened production, while others are threatened by extinction. Commercial production will of necessity be governed by economic law; use will be dependent on production, but both must be free of waste and governed by intelligent foresight. There are important natural resources whose commercial uses are less obvious but whose depletion is a grave disturbance of the balance of nature.

This is a problem of the public welfare. Its solution should marshal not only scientific knowledge and the economic interests of the country but also the moral forces of the body politic. Organized effort to safeguard our natural heritage must come quickly. As use becomes greater, abuse and wastage must be diminished.

This Executive Committee does not assume a supervisory attitude in matters of conservation but seeks to advise, coordinate and substantiate outstanding organizations. It sets forth the following program as expressive of its purpose:

1. The problem is a basic one in public welfare. It should therefore challenge intelligent attention, command public confidence and receive necessary financial support.

2. This movement is at present representative of the scientific membership and functions of its parent societies, the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science. The committee may be enlarged from time to time by the addition of members of experience and wisdom; but its work must be of a character truly to represent its parent organizations. It

should keep in close touch with their governing bodies, and annually present a report to their councils. The results of the work will carry the weight of the associated leaders of science in America.

3. Essential to the purposes of the undertaking is a competent and vigorous executive, composed of a director or executive secretary with necessary expert and clerical assistance. The functions of this executive are provisionally outlined thus:

(*a*) To assemble, classify and correlate all outstanding activities in the scientific and industrial conservation of natural resources; with the purpose of bringing these into effective juxtaposition and concentration and thus produce an active army of organized workers directed to a common end without duplication of effort or cost. The former is essentially statistical; the latter is directive and requires a skillful exercise of judicious procedure and tactful guidance.

(*b*) To effect active cooperation with the officers and directorates of existing organizations concerned with natural resources.

(*c*) To assemble available data relating to the status of our natural resources, to enlist therefor such industrial and other agencies as are actively engaged therewith, to interpret these data in relation to protection and reserve, as well as to the economic and social welfare of the state, and to provide a broad scientific basis for legislative action by the state and the federal government.

(*d*) To initiate and judiciously enforce by education recognition of the principle underlying the protection and use of natural resources.

It is held that this recognition can be made most effective and enduring by implantation in the minds of the children of the elementary schools; that in schools of higher grade, in colleges and universities, and in schools of engineering and applied science this principle can be enforced by correct teaching in already established courses. Extravagance of statement and emotionalism must be cautiously avoided. Teachers must themselves be taught not only to inculcate this principle but to do it wisely. Advantage must be taken of existing channels of educational approach through the state educational organizations and the state executives, in which the Division of States Relations of the National Research Council may helpfully cooperate.

It is held that the proper teaching of the conservation principle is a most effective safeguard for the future of this nation. This undertaking will therefore involve uninterrupted effort with the eventual aid of proper texts, the probable establishment of a bureau of lecturers who may reach the public outside the schools, and the utilization of all modern accessories to effective educational appeal.

Supplementary

Cost of the work.—The cost of the work is estimated as $25,000 per annum, distributed as follows:

Salaries		
Executive Officer	$10,000	
First Associate	5,000	
1 Clerk	1,600	
1 Clerk	1,500	
1 Clerk	1,400	
		$19,500
Traveling Expenses		2,000
Office Rent		1,000
Office Expenses		
Including telephone, telegrams, stationery, postage, etc.		500
Printing, Drafting and Contingent		1,800
Total		$25,000

Financing.—It is desirable, if possible, to secure a permanent fund of $500,000 whose income would be available for the work in contemplation. In that event, a separate foundation could be established, or the fund could be given to the National Academy, the National Research Council, or the American Association for the Advancement of Science with provision for the use of the income for the work of this committee.

In case the funds are in the form of annual contributions, it is desirable to plan in advance for a certain income to cover a period of not less than five or ten years. Reasonable

permanence should be given the project before its formal undertaking.

John M. Clarke,
Henry S. Graves,
Barrington Moore,
Committee on Program

June 3, 1921

SCIENTIFIC EVENTS

THE INCREASING USE OF UNITED STATES GEOLOGICAL SURVEY MAPS

The project of covering the 3,000,000 square miles of the United States with accurate topographic surveys was definitely adopted by the federal government in 1882. The project was large, and the work is even now less than half completed. The standards of accuracy and refinement in topographic surveying have been constantly raised by the topographic engineers of the United States Geological Survey, Department of the Interior, with the view of meeting adequately every use to which the maps can be put. The law provides for the sale of the maps made by the Geological Survey at the cost of printing, a charge that must be considered merely nominal when it is realized that the cost of an edition of a printed map may be only a small percentage of the cost of surveying the area it represents.

The government itself is making a large and increasing use of these topographic maps, but the expenditure of public funds for these surveys is otherwise fully warranted only as the public uses the maps. To promote this use, the Geological Survey has recently given more attention to the wider distribution of the maps.

The distribution of a government map depends largely upon publicity, though the necessity of adopting commercial business methods in handling orders for the maps when a demand is created must not be overlooked. To inform the public of the existence of authoritative maps published by the federal government a special effort is now being made to reach the communities in every area that is covered by a map, and to this end every map as issued is brought to the attention of the local and state press.

Other methods of promoting wider distribution involve the cooperation of boy-scout masters, schoolboys, and hotel managers, as well as of a large number of bookstores as local agents. Helpful publicity has also been gained through the voluntary cooperation of the press. The printing in a single publication of a brief statement regarding the Geological Survey's maps often results in orders for a hundred or more maps and many inquiries for the State index maps, which are sent free, showing the areas already mapped.

The periods of maximum demand for these government maps are the beginning of the vacation period and the beginning of the school year.

THE ROYAL SOCIETY CONVERSAZIONE[1]

The annual conversazione of the Royal Society was held at Burlington House on May 11, and was so well attended that it was practically impossible to see a tenth part of the exhibits and demonstrations. Fortunately arrangements are always made for an earlier press view of the latter. This year amongst the thirty-nine demonstrations figuring in the catalogue there was none having any direct bearing on medical science, though the exhibition contained much of great general interest. Mr. L. T. Hogben, of the Imperial College of Science, demonstrated the effects on tadpoles of feeding them with pineal gland. Hitherto there has been no proof of any physiological function exercised by the pineal body, but Mr. Hogben has succeeded in showing, in tadpoles at least, that it has some controlling power over the pigment cells. Macroscopic and microscopic preparations showed that in the pineal-fed tadpoles there is a very evident contraction of the melanophores, an effect that is not produced by feeding experiments with any other endocrine organ. Mr. C. Tate Regan, F.R.S., gave a demonstration of part of the life-history of the common eel, founded on the researches of Dr. J. Schmidt, who showed that the freshwater eel of Europe breeds in the Atlantic, southeast of Bermuda. A series of larvæ, from the middle and western North Atlantic, with long and slender pointed

[1] From *The British Medical Journal.*

teeth, were exhibited, together with a photograph of the metamorphosis into the elver. The accompanying models illustrated the changes from the yellow eel with its thick lips, small eye, and compact pectoral fin, into the thin-lipped, large-eyed silver eel with pointed pectoral fin, the latter form of eel being that which migrates to the ocean to become mature. Dr. John Rennie demonstrated the mite, now named *Tarsonemus woodi*, which has been claimed by Bruce White to be the causal agent of Isle of Wight disease in bees. White showed that the mites perforate the tracheæ, and by their numbers obstruct the spiracles and thus deprive the bees of the power of flight. Mr. J. E. Barnard gave a demonstration of the microscopic appearances of sections by ultra-violet light. Certain structures, owing to their differences in chemical composition, give different fluorescent tints, and the images obtained are often dissimilar to those obtained by ordinary staining methods. The light filter used was a glass made by Chance, which is transparent to the ultra-violet radiations, and the quartz substage condenser was of the "dark-ground" type. A most interesting and instructive astronomical model designed for educational purposes was exhibited by Dr. William Wilson. This model, which has received great praise from leading astronomers and teachers, not only demonstrates the more familiar motions of the sun, earth, and moon, and the various phenomena resulting therefrom, but is capable of simple analyses of each particular motion. The apparatus is most ingenious.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE E. DE SCHWEINITZ, professor of ophthalmology at the University of Pennsylvania, was elected president of the American Medical Association at the meeting held last week in Boston. Other officers were elected as follows: Frank B. Wynn, of Indianapolis, vice-president; Dr. Alexander R. Craig, of Chicago, and Dr. William Allen Pusey, of Chicago, were reelected secretary and treasurer, respectively.

AT the recent commencement of New York University, the degree of Doctor of Laws was conferred on Dr. George David Stewart, professor of surgery at the university.

THE honorary degree of Doctor of Science was conferred upon C. L. Marlatt, assistant chief of the Federal Bureau of Entomology, and chairman of the Federal Horticultural Board, by the Kansas State Agricultural College at its fifty-eighth commencement on June 2, "in recognition of his contributions to our knowledge of insects and his efficient services in initiating the policies and directing the work of the Federal Horticultural Board."

THE degree of doctor of engineering will be conferred by the Stevens Institute of Technology on Dr. Sven Wingquist, the Swedish engineer, who comes to the United States by invitation of the institute on the occasion of the celebration of its fiftieth anniversary.

DR. WM. CURTIS FARABEE, president of the American Anthropological Association, has been elected a corresponding member of the National Academy of History, Ecuador.

THE Adams prize of the University of Cambridge has been awarded to Dr. W. M. Hicks, St. John's College.

THE friends and former students of Professor A. Swaen are planning to place a tablet in his honor in the Institute of Anatomy at the University of Liége where he has taught for thirty years.

DR. T. W. FULTON, scientific superintendent of the Fishery Board for Scotland, has retired after a service of thirty-four years.

MR. BRADLEY STOUGHTON has resigned the secretaryship of the American Institute of Mining Engineers, which he has held since 1913. Mr. Stoughton's resignation is in accordance with his personal belief that the office of secretary of the institute should not be permanent, since too long a tenure of office is likely to create relations that can not be terminated agreeably. During Mr. Stoughton's tenure the membership of the institute has increased from 3,500 to over 9,000.

The National Academy of Sciences has appropriated from the J. Lawrence Smith Fund $300 for the preparation of manuscripts by Mabel Weil on the work of the late Professor C. C. Trowbridge accomplished under a previous grant, on meteor trains and aurora phenomena.

The Committee on Scientific Research of the American Medical Association has granted Professor Frank P. Underhill, of Yale University, the sum of $300 for expenses in connection with an investigation on the metabolism of inorganic salts, and $400 to Dr. Wm. H. Welker, of the University of Illinois, College of Medicine, for assistance in an investigation on the fractionation of bacterial proteins.

Officers for 1921–1922 of the Boston Society of Natural History have been elected as follows: *President,* W. Cameron Forbes; *Vice-presidents,* Nathaniel T. Kidder, William M. Wheeler, Theodore Lyman; *Secretary,* Glover M. Allen; *Treasurer,* William A. Jeffries; *Councilors for three years,* Reginald A. Daly, Merritt L. Fernald, William L. W. Field, George H. Parker, John C. Phillips, Charles H. Taylor, Jr., Edward Wigglesworth, Miss M. A. Willcox.

At the annual meeting in April of the California Botanical Society the following officers were elected: *President,* Dr. W. L. Jepson, professor of botany in the University of California; *First Vice-president,* Dr. L. R. Abrams, associate professor of botany in Stanford University; *Second Vice-president,* Mr. W. W. Mackie, assistant professor of agronomy in the University of California; *Secretary,* Mr. H. E. McMinn, professor of botany in Mills College; *Treasurer,* Mrs. Adeline Frederick, Berkeley, California.

Officers of the Southwestern Geological Society elected at the March meeting of the society at Tulsa, Oklahoma, were as follows: E. H. Sellards, president; C. Max Bauer, vice-president; H. P. Bybee, secretary; R. B. Whitehead, treasurer. Members of the council are: J. A. Udden, C. A. Hammill, E. W. Shuler, W. E. Wrather, J. G. Bartram and R. T. Hill. Sections of the society are now established at Austin, Texas; Ardmore, Oklahoma; Dallas, Texas; Lawton, Oklahoma; Okmulgee, Oklahoma; and Shreveport, Louisiana. The next general meeting will be held in the spring of 1922.

Dr. Colin G. Fink, of South Yonkers, who organized and for the past four years directed the research laboratories of the Chile Exploration Co., has resigned. Dr. Fink has been editor of the "Electrochemistry" section of *Chemical Abstracts* since 1907.

David B. Reger, assistant geologist of the West Virginia Geological Survey, will spend the present field season in Grant and Mineral Counties, making researches for a complete geological report on the area mentioned. Temporary headquarters will be at Piedmont.

The government of Panama has purchased a bronze bust of the late General William C. Gorgas, which will be placed at the entrance of the Santo Tomás Hospital at Panama. The *Journal* of the American Medical Association states that President Porras of Panama, in writing to the English sculptor in charge of the work, P. Bryant Baker, has stated, "We appreciate very deeply the sanitary work accomplished by Dr. Gorgas in Panama and feel this is one of the most appropriate ways of showing our gratitude."

William Brown Cogswell, the mining engineer, founder of the Solvay Process, died on June 7, aged eighty-seven years.

Two fellowship have been established by the honorary scientific society, Sigma Xi, which will pay a maximum of $1,800 each for the academic year, beginning in the fall of 1921. The funds for these fellowships have been contributed by the voluntary offerings of the members of the Sigma Xi scattered throughout the country, many of whom have agreed to contribute $2 a year for the purpose of encouraging graduate students to engage in scientific investigation. The fellowships are intended for those who have already received a doctor's degree. Applicants should present

their qualifications to Dean Edward Ellery, Union College, Schenectady, N. Y., before August 1.

AT the annual meeting of the American Association of Pathologists and Bacteriologists, held in Cleveland on March 24, it was voted to hold the next meeting in connection with the Triennial Congress of American Physicians and Surgeons in Washington, during May, 1922. The officers elected for the year were: *President,* Harry T. Marshall; *Vice-president,* Paul A. Lewis; *Secretary,* Howard T. Karsner; *Treasurer,* Frank B. Mallory. Other members of the Council are: Dr. Eugene L. Opie, Dr. Oskar Klotz, Dr. James Ewing, Dr. H. E. Robertson.

THE *Journal* of the American Medical Association states that an organization has been formed, the *Notgemeinschaft* for German science, which has been discussing ways and means to promote scientific research in Germany. The *Medizinische Klinik* quotes from the proceedings that, of the total 3,000 German scientific periodicals, 400 are to be continued with the aid of the organization. To make up for the lack of foreign publications during the war, a large sum will be appropriated to insure that all the important foreign journals will be represented in Germany at least by one or two copies of those published during the last few years, while the current numbers will be obtained by exchange. A purchasing and loan center for scientific material and instruments is to be installed at some central point to maintain the experimental research of the country on a higher limit. It is also planned to supply animals for experiments in medical and biologic research.

THE University of Michigan Biological Station will hold its thirteenth session for instruction and research on the shores of Douglas Lake, Cheboygan County, Michigan, from July 5 to August 26. Instruction in zoology will be given by Professors George R. La Rue and Paul S. Welch, University of Michigan; Frank Smith, University of Illinois; Zeno P. Metcalf, North Carolina State College of Agriculture and Engineering; and in botany by Professors Frank C. Gates, Kansas State Agricultural College; George E. Nichols, Yale University, and John H. Ehlers, University of Michigan. Mrs. Lois S. Ehlers, of Ann Arbor, is to be dean of women. Mr. Harry C. Fortner, University of Tennessee; Dr. Minna E. Jewell, Milwaukee-Downer College; and Miss Alice E. Keener will serve as assistants. Under certain conditions, properly qualified graduate students may complete the requirements for the M.A. or M.S. degree by working at the station through three or four summer sessions. Inquiries should be addressed to Professor George R. La Rue, director, University of Michigan, Ann Arbor, Michigan.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $300,000 has been made by the General Education Board to the million-dollar endowment fund of the University of the South.

DR. PHILLIP B. WOODWORTH, formerly dean of the engineering faculty at Lewis Institute and recently in charge of the educational work of the government as director of the Central District, has been elected president of the Rose Polytechnic Institute.

PROFESSOR HENRY P. TALBOT, professor of analytical chemistry and chairman of the faculty, has been appointed acting dean of the Massachusetts Institute of Technology.

AS one step in the reconstruction plans of Yale University the subjects of pharmacology and experimental medicine have been combined as a university department with the title of department of pharmacology and toxicology, the chairman of which is Dr. Frank P. Underhill. The functions of the new department are three-fold: teaching, research and service to the community and state. Special attention will be devoted to the training of future investigators and teachers, and to the chemistry and physiology of the action of drugs and poisons.

AT the University of Pennsylvania, the fol-

lowing promotions have been made: Dr. C. B. Bazzoni to be professor of physics, Dr. George Gailey Chambers and Dr. Howard Hawks Mitchell to be professors of mathematics and Dr. Karl Greenwood Miller to be assistant professor of psychology.

DISCUSSION AND CORRESPONDENCE

THE GEOGRAPHICAL DISTRIBUTION OF HYBRIDS

It is often assumed by systematic botanists in this country that natural hybrids between species can only exist within the common range of the parent species. This opinion has been emphasized in a caustic criticism of Brainerd and Peitersen's recent article entitled "Blackberries of New England—their classification."[1] In the article cited,[2] the following expression appears:

> . . . no one, not specially forewarned or gifted with remarkable intuition, finding *Rubus frondisentis* (*"R. pergratus* × *setosus"*) superabundant in Coos County, New Hampshire, *R. glandicaulis* (*"R. allegheniensis* × *sentosus"*) in the thickets of Prince Edward Island, where *R. setosus* is unknown, or *R. arenicola* (*"R. Baileyanus* × *frondosus"*) dominant on dry barrens of Nova Scotia where *R. Baileyanus* is unknown and where *R. frondosus* is represented only by *R. recurvans*, can guess in which key to trace his species.

A number of similar quotations might be cited from the same source all involving the negation of the possibility of the occurrence of a hybrid beyond the range of the parent species.

It would seem reasonable to appeal to the better known floras of Europe in a case of this kind, and no one can perhaps be quoted with more effect on this important subject than Anton Kerner von Marilaun. In the second volume of his classic "Pflanzenleben," as well as in the "Osterreichische botanische Zeitschrift" (Vol. 21 (1871)), this distinguished author has cited a large number of cases of natural hybrids.

Perhaps the most interesting example in this connection is the hybrid *Nuphar intermedium* which is a cross between *Nuphar luteum* and *Nuphar pumilum*, found distributed from the Black Forest and the Vosges northward into Russia and Lapland. In the southern part of its range, the hybrid is rarer and less fertile than it is further north. It is capable of extending its latitude northward of the range of both the parent species. Parallel cases are supplied by hybrids of *Epilobium, Brunella, Primula, Linaria, Rumex, Micomeria, Pulsatilla*, etc. In these various genera Kerner describes hybrids between wild species which often occur beyond the range of one or both of the parent species. Since the data supplied by Kerner on this subject can scarcely be questioned, it would appear that the absence of one or both of the parent species of a supposed hybrid in a given region is no valid argument against the hybrid origin of such an intermediate form. We have apparently still much to learn from our European colleagues both as regards accuracy and breadth of view in the matter of geographical distribution of hybrids. In the light of the above it does not appear necessary that the statements of Brainerd in regard to probable natural hybrids of *Rubus* should be accorded less credence and respect than have been given to his classic results in the case of natural hybrids in the genus *Viola*.

E. C. Jeffrey

Harvard University

[1] Vermont Agricultural Experiment Station, Bulletin 217, Burlington, Vermont.

[2] *Rhodora*, Vol. 22, pp. 185–191.

STAR DIAMETERS

To the Editor of Science: Referring to the communication of Professor Fessenden concerning star diameters (Science, March 25, 1921, page 287–8), allow me to say that it does not seem possible that the measured diameter of Betelgeuse is affected by a gravitational displacement. In the first place, there are stars, of solar type for example, in connection with which the conditions would seem to be far more favorable for such a displacement and yet these objects show no appreciable disk. Further, we know that light reacts to a gravitational field in such a manner that there is no permanent acceleration in the direction of propagation. This fact reduces the possibility of a displacement to a

rotation of the plane of the wave front, which would not increase the apparent diameter of a star.

In the case of either an orbital displacement or a rotation of the wave front, the observed deflection decreases with the distance and would be inappreciable at stellar distances. It can be shown that the sun at the distance of the nearest star would show a displacement at the limb, on the Einstein hypothesis, amounting to less than one millionth of a second of arc, if the deflected beam originated in a neighboring companion.

KELVIN BURNS
ALLEGHENY OBSERVATORY

RUSSIAN SCIENTIFIC MEN

TO THE EDITOR OF SCIENCE: Attention has been called in SCIENCE to the British "appointments committee for Russian scientific and literary men," under the chairmanship of Sir Arthur Schuster. Many Russians distinguished in various branches of learning are at present scattered over European countries, some of whom are destitute, while others are earning a precarious livelihood by work in which they have no opportunity of exercising their particular capabilities, the world at large thus losing the benefit of their knowledge and aptitude.

The object of the committee is to bring the names and qualifications of some of these men to the notice of universities and other institutions outside of Russia which may be able to offer them suitable employment. Lists of these names have been sent by the committee to various universities and organizations and the National Research Council has just arranged to send similar lists to the presidents of about two hundred colleges and universities in this country.

The council has also received a circular letter from a committee of meteorologists and geophysicists of Vienna which asks if certain kinds of statistical and preparative work needed by meteorologists and geophysicists of this country can not be done, for pay, in Vienna. These meteorologists and geophysicists have access to many valuable sources of statistics and general data and appeal for opportunity to do this work in order to assist in supporting themselves. Any communications which it may be desired to make to this committee should be addressed to Dr. A. Wagner, Zentralanstalt für Meteorologie, Hohe Warte 38, Vienna XIX.

VERNON KELLOGG
NATIONAL RESEARCH COUNCIL
May 27, 1921

SPECIAL ARTICLES

A CONVENIENT CULTURE MEDIUM FOR DAPHNIDS

Daphnia and other Cladocera may be fed upon certain unicellular green algæ, a mixture of various protozoa and protophyta obtained from the sediment of ponds in which there is a considerable quantity of organic matter, or upon bacteria.

For more than five years the writer successfully utilized material from ponds in obtaining food for Cladocera cultures representing several species. The somewhat discolored water was dipped up in such a manner as to obtain considerable amounts of the loose fluffy sediment lightly resting upon the bottom. In the strainings which followed (through silk bolting-cloth, to prevent contamination of the laboratory stock) much of this sediment was rubbed through the straining cloth and distributed with the water to the culture bottles (about 100 c.c. in quantity in ordinary wide mouthed 200 c.c. bottles). This method of obtaining culture water containing the proper food organisms has certain limitations. The water and sediment from most ponds do not constitute a proper culture medium; a pond from which a good culture medium may be obtained is hard to find. Further from month to month and season to season such a pond undergoes wide fluctuation in its usefulness as a source of daphnid food; it may even dry up and one's Cladocera material be imperilled or lost.

Some workers using algæ have cultivated them in jars of water; others on agar plates. The necessity for obtaining just the proper sorts of algæ and the requisite skill in their

cultivation make this method of obtaining proper food for Cladocera perhaps less useful in some cases than the one now to be described.

It seemed desirable to have a culture medium which could be readily obtained anywhere and at any season of the year. Such a medium has been obtained as follows: two pounds of fine garden soil are placed in a large battery jar (9 in. diameter); to this are added six ounces of finely divided fresh (8 to 15 days old) horse manure and the whole is covered with 10 quarts of strained pond water. Pond water is specified because Cladocera are extremely susceptible to the toxic effects of the salts of the heavy metals. Tap water should be used with caution until proved innocuous. The mixture is allowed to stand at 15° to 20° C. without disturbance for three days when it is strained through silk bolting-cloth. The proper straining is facilitated by carefully dipping out and straining most of the supernatant liquid and then agitating the remainder and with it rubbing a very small portion of the soil through the straining cloth. The solution is then ready for use, though in addition to being thoroughly stirred before being placed in the culture bottles it is usually diluted by adding pond water in the proportions of from 1 to 4 to 1 to 2, depending upon the degree of density in the appearance of the solution.

This culture medium has proved extremely useful to the writer and is now used exclusively for all his Cladocera cultures. No renewal of the solution in a culture bottle is ordinarily required during the life of an individual Cladoceran. Not every make-up of food proves equally satisfactory but persons unaccustomed to handling such culture water quickly learn the proper handling and dilution and very soon obtain excellent results. This soil-manure solution is equally practicable for rearing copepods and some, at least, of the rotifers.

Bacteria constitute the principal food element in this culture medium. While a certain amount of uniformity is attainable in such a culture medium, such mass cultures are quite variable and it is obvious that this can scarcely be considered a "standard" food. It is probable that the proper bacteria could be reared on agar plates, definite quantities introduced into the culture bottles at definite intervals and a really standard food thus obtained.

Arthur M. Banta
Station for Experimental Evolution

THE NEBRASKA ACADEMY OF SCIENCE

The thirty-first meeting of the Nebraska Academy of Science, held in Bessey Hall, University of Nebraska, Lincoln, on April 1 and 2, was one of the most interesting in the history of the organization. The attendance was about one hundred, comprising many educational institutions of the state and one or two from adjoining states. The program was so full it was divided into three sections. A very pleasant feature was the annual dinner held in Ellen Smith Hall, followed by President Walker's address, and a general discussion of the needs and interests of the Academy. Dr. Walker made a number of recommendations and suggestions for the advancement of the organization, which has suffered in the past from a lack of the interest and enthusiasm which usually mark the annual meetings. The harvest time of the organization is between the annual meetings, if the officials are sufficiently active and progressive.

At the business session on Saturday morning a number of new members and the following officials for the coming year were selected: *President*, J. C. Jensen, Nebraska Wesleyan University; *Vice-president*, H. O. Sutton, Teachers' College, Kearney; *Secretary*, Rose Clark, Teachers' College, Peru; and *Treasurer*, P. K. Slaymaker, University of Nebraska. A number of amendments to the constitution were approved and the offer of Dr. Sheldon, of temporary headquarters for the academy with the Legislative Bureau, was accepted. University Place was chosen for the 1922 meeting.

W. F. Hoyt,
Secretary